

REMARKS

Claim 1 has been amended. Claims 2-5 have been cancelled. Claims 7-8 have been added. Claims 1 and 6-8 remain pending. Reconsideration and reexamination of the application, as amended, are requested.

The Examiner rejected claims 1-6 under 35 U.S.C. 103(a) as being obvious on consideration of Coles in view of Nishiyama et al.

Coles discloses an electric motor for incorporating in an electric power steering system. The motor 12 has a rotor 300 and a stator 400. The stator is disclosed to have nine poles 401 with windings thereon. The rotor is disclosed to have six permanent magnets 301 located within slots 302 with alternate north and south polarities. The motor is driven by three phase power. The windings on the poles are connected serially in series, i.e., ABCABCABC (see Figure 2).

Nishiyama discloses a motor having a rotor 3 with eight magnets 14. The stator 2 has twelve slots carrying a winding wound as a single winding. There is no disclosure regarding a winding pattern of the stator.

Claim 1 has been amended to reflect the winding pattern of Figure 11A. Claim 7 has been written to reflect the winding of Figure 9A.

There are enclosed sketches A, B and C as an aid in understanding the discussion which follows. Sketch A depicts the motor of claim 1; sketch B depicts the motor of claim 7; and sketch C depicts an imaginary motor developed according to a hypothetical of Coles and Nishiyama.

With reference to sketch A, the stator windings are shown as every other winding being connected in series. They have equal pitch. The rotor has eight poles of equal pitch so that N and S poles are alternately arranged. As shown at the bottom of the sketch A, one of the stator winding groups would not provide any net polarity. A net polarity is shown for the other two groups. There are nine stator windings equally arranged. The rotor is likewise depicted with eight alternate poles (with a ninth shown as the beginning of the next rotation). The black arrows depict a net attraction or repelling of magnetic forces at a representative instant of time as the rotor rotates past the stator. It is seen that there is a significant net increase of torque particularly to the right of the sketch.

Sketch B, depicting claim 7, shows stator windings positioned adjacent to each other being connected in series. The rest of the figure is configured similar to sketch A. Again there is a significant net increase of torque as shown near the right of sketch B.

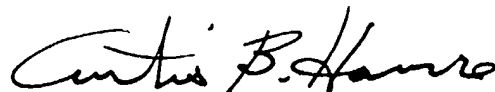
With respect to sketch C, Applicants firstly do not agree that there is motivation in either reference for the reference to be considered with the other reference by one skilled in the art to change the number of permanent magnets in the rotor from six in Coles to eight as disclosed in Nishiyama, except on hindsight analysis of Applicant's invention. Nevertheless, assuming for the sake of argument a motor as disclosed in Coles and replacing the rotor to be the one of Nishiyama so that there are nine stator windings and eight rotor magnets, and assuming the serial wiring connection disclosed in Coles, then the depiction in the lower part of sketch C may result. Even if a motor were developed in this way, due to the wiring disclosure of Coles, it is clear that both repelling and attraction forces develop in one portion (the right side) of the lower depiction of sketch C. Thus, there develops a cancelling of forces. Hence, the net torque from a motor like this would be substantially less than that of either sketch A or sketch B. It is Applicants' position that any consideration of Coles and Nishiyama together, even in their most likely configuration after hindsight analysis of Applicants' invention, that they do not point to the motors of claims 1 and 7 because of inadequate development of net torque as compared to the motors of claims 1 and 7. Hence, the independent claims and the claims which depend from them are not obvious in view of these references.

In view of the above, it is submitted that the application is condition for allowance. Reconsideration and reexamination are requested. Allowance of claims 1 and 6-8 at an early date is solicited.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims

Claims 2-5 have been cancelled.

Claim 1 has been amended to read as follows:

1. (Twice Amended) An electric power steering apparatus including an electric motor for applying a steering assist torque, corresponding to a steering torque, to a steering system, said electric motor comprising:

an annular outer stator having circumferentially arranged [stator windings of nine or a multiple of nine poles] nine salient poles radially arranged at an equal pitch, each of said salient poles having a stator winding wound therearound; and

an inner rotor positioned within said outer stator and consisting of permanent magnets of eight poles magnetized radially arranged at equal pitch so that N and S poles are alternately arranged circumferentially;

said stator windings being connected as groupings such that they can be driven by electric power of three phases, each of said groupings comprising three poles of said stator windings which are positioned as every other one of said stator windings for said three poles, said stator windings in each grouping being connected in series.

Claims 7 and 8 are new.